



Worksheet #13

Assessing the risk of water contamination from **Nutrient Management Practices**

Why should you be concerned?

Soil nutrients need to be properly managed to meet the fertility requirements of crops without adversely affecting the environment. The soil nutrients of greatest concern for protecting water quality are nitrogen (N) and phosphorus (P).

Nitrogen not used by a crop can move below the root zone, a process called leaching, and eventually contribute nitrate to groundwater. Nitrate is the most common groundwater contaminant found in Vermont. Nitrate levels that exceed the established drinking-water standard of 10 ppm nitrate N have the potential to adversely affect the health of infants and livestock.

Surface-water quality can be harmed with the addition of nutrients. Erosion and runoff from fertile cropland to lakes, ponds, and streams add nutrients that stimulate the excessive growth of aquatic weeds and algae. Phosphorus is the most important nutrient to prevent from reaching surface water because P stimulates excessive growth of aquatic plants and algae. This growth can result in serious consequences for lakes: It can deplete their oxygen levels, resulting in fish kills, and reduce the aesthetic and recreational values of lakes.

Nutrient management practices for minimizing water quality impacts vary widely and are dependent upon soil, cropping, topographical, weather, and economic conditions. For example, careful management of N should be a priority on sandy soils to control nitrate leaching to groundwater; minimizing runoff and erosion should be a primary goal on sloping cropland fields.

Because of the variety of factors to consider in crop fertility management, it is nearly impossible to identify best management practices applicable to all Vermont farms. Nutrient management practices for preserving water quality need to be tailored to the unique conditions of individual farms. This worksheet lists many agricultural practices that can influence the contribution of soil nutrients to water resources. Not all the practices described are applicable to all farms. However, completing the nutrient management assessment should allow you to prioritize management practices that need to be modified to protect the quality of nearby water resources.

How will this worksheet help?

- * It will take you step by step through your nutrient management practices.
- * It will help you rank your nutrient management practices according to how they may affect water quality on your farm.
- * It will provide you with easy to understand rankings that will help you analyze the risk level of your nutrient management practices.
- * It will help you determine which of your nutrient management practices are reasonably safe and effective, and which practices might require some modification to better protect your water resources.

The goal of Farm*A*Syst is to help you protect the groundwater that supplies your drinking water.

Glossary

These terms may help you make more accurate assessments when completing this worksheet.

Ammonium forms of N fertilizers: Ammonium nitrate, ammonium sulfate, anhydrous ammonia, nitrogen solutions, urea.

Band application: A technique for applying starter fertilizer at planting. Fertilizer is applied in a band about 2 inches below and 2 inches to the side of the seed.

Broadcast application: A method of applying fertilizer in which it is uniformly spread over the surface of fields.

Composite soil sample: A soil sample submitted for testing that is an accurate representative of the sampling area (such as a cropland field). A composite sample should consist of at least five individual soil cores per 5 acres.

Cover crops: Densely seeded crops (such as rye, oats, and wheat) planted in the interim period between principal crop production to protect soil from erosion.

Highly erodible land (HEL): Cropland fields that have an erosion index of 8 or greater. Such fields are required to be farmed according to an approved conservation plan as specified in the 1985 Farm Bill (Food Security Act).

Irrigation scheduling: Planning crop irrigation frequencies and amounts based on soil, crop, climatic, and management factors.

Legume nitrogen credit: Amount of nitrogen available to a crop following a legume crop (such as alfalfa, clover, and soybeans) in the rotation. This amount of nitrogen should be deducted from the crop's base nitrogen fertilizer recommendation.

Manure nutrient content: Amount of crop nutrients available from a given unit of manure, usually expressed in pounds of nutrient (N, P 2 O 5 , K 2 O) per ton or per 1,000 gallons of manure. Determined either through manure sample analysis or use of University of Vermont laboratory averages (book values).

Multiple delayed applications: Nitrogen applications in which fertilizer is applied in several increments during the growing season, with none of the fertilizer being applied prior to planting.

Nitrification inhibitor: A compound added to ammonium or ammonium forming nitrogen fertilizers to slow the conversion of ammonium to nitrate, which reduces the potential for nitrogen losses that occur in the nitrate form (such as leaching and denitrification).

Nutrient credits: The amount of crop nutrients available from noncommercial fertilizer (such as manure and organic waste) applications to cropland, legumes grown in rotation with grain crops, carry over soil nitrate, and so forth. The amount of the nutrient credit is determined and then deducted from the base fertilizer recommendation. Accounting for nutrient credits can result in economic and environmental benefits.

Optimum soil test values: The mid-range of soil test values (or levels) for phosphorus and potassium. At optimum soil test values, fertilizer additions are approximately equal to the crop's nutrient use.

Routine soil testing: Analyzing of soil samples to estimate the major nutrient (nitrogen, phosphorus, and potassium) supplying capacity of a given soil as well as pH. Fertilizer and lime recommendations are based on soil test results.

Sidedress application: A method of applying fertilizer, typically nitrogen, in which it is placed next to or between crop rows during the growing season.

Soil sampling: Collecting a soil sample that will be analyzed for nutrient supplying capacity; this, in turn, leads to a fertilizer recommendation. The sample must be representative of the field from which it is collected to ensure accurate fertilizer recommendations.

Soil test phosphorus: Soil test value for phosphorus determined through routine soil testing. Expressed in parts per million (formerly pounds per acre) and assigned an interpretation of either very low, low, optimum, high, or excessively high.

Soil nitrate test (PSNT): Soil test that measures soil nitrate-nitrogen when corn plants are 8 to 12 inches tall. Use of the Pre-sidedress Nitrate Test (PSNT) can improve the efficiency of nitrogen fertilizer applications to corn by adjusting nitrogen fertilizer recommendations for field specific conditions.

Split applications: Nitrogen fertilizer applications where the fertilizer is applied in several increments during the growing season.

Spreadable cropland: Cropland that is environmentally, economically, and agronomically suitable for the application of manure.

Starter fertilizer: An in row (banded) application of fertilizer placed near the seed to promote vigorous seedling growth by providing a high concentration of readily available nutrients. Starter fertilizer is most valuable on cool, wet soils.

Tolerable soil loss (T): A defined annual rate of soil erosion that if exceeded would remove soil from the landscape faster than it is being formed. One long-term effect of exceeding T rates is reduced soil productivity. Tolerable soil loss rates vary among soil types; however, the majority of rates are from 3 to 5 tons/acre/year.

University of Vermont fertilizer recommendations: Fertilizer recommendations based on soil test results and university research specific to the soils and cropping conditions found in the state of Vermont.

Yield goal: A criterion used in determining phosphorus and potassium fertilizer recommendations. Crop yield goals should be realistic and based on records from previous years. Yield goals should not be more than 10 to 15 percent above the previous 3 to 5 year average.

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Rank 4

Rank 3

Rank 2

Rank 1

Field Number

Routine Soil Testing					
Frequency of routine soil tests	Cropland fields are tested every 1-3 years; every year for vegetable crops.	Cropland fields are tested every 4-6 years; every other year for vegetable crops.	Cropland fields are tested every 7+ years; every 3-4 years for vegetable crops.	No soil testing conducted.	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Sampling density	At least 15-20 soil cores are collected from field areas not more than 10-20 acres to form a composite soil sample	10-15 soil cores are collected from field areas not more than 10-20 acres to form a composite soil sample	5-10 soil cores are collected from field areas not more than 10-20 acres to form a composite soil sample	Fewer than 5 soil cores are collected from field areas of 10-20 acres or more to form a composite soil sample	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Nutrient application rates	Nutrient application rates do not exceed University of Vermont recommendations.	Nutrient application rates exceed University of Vermont recommendations by 10-25%.	Nutrient application rates exceed University of Vermont recommendations by 25-50%.	Nutrient application rates exceed University of Vermont recommendations by greater than 50%.	
Yield goal estimates	Fertilizer recommendations are based on yield levels within 10% of 5-year+ average for each field.		Fertilizer recommendations are based on yield goals using the highest yield ever obtained on each field.	Fertilizer recommendations are based on yield goals I hope to reach sometime. Or Measured yield information is not used to determine fertilizer recommendations.	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Pre-sidedress Soil nitrate test (PSNT) for corn					
	Pre-sidedress Nitrate Test (PSNT) is used annually on all corn fields to determine N	PSNT is used on most corn fields in most years to determine N fertilizer rate.	PSNT is used occasionally to determine N fertilizer rate on corn fields.	PSNT is never used.	

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	fertilizer rate.				
Nutrient credits					
Manure					<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Application rate	Manure is applied to fields at rates not exceeding the nutrient need of the crop to be grown.	Manure is applied to most fields at rates not exceeding the nutrient need of the crop to be grown.	Manure is applied to most fields at rates exceeding the nutrient need of the crop to be grown.	Manure application rate to fields is unknown.	
Nutrient content	Manure nutrient content is determined through laboratory analysis.	Manure nutrient content is estimated using University of Vermont laboratory averages or provided by UVM soil test report.		Manure nutrient content is unknown.	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Crediting	Manure nutrient credits are confirmed through the use of a pre-sidedress soil nitrate test and fertilizer application rates are reduced accordingly.	Manure nutrient credits are calculated and fully deducted from fertilizer application rates.	Manure nutrient credits are partially deducted (at least 50%) from fertilizer application rates.	Manure nutrient credits are not deducted from fertilizer application rates.	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Legumes					
	Legume nitrogen credits are calculated according to University of Vermont guidelines (as in UVM soil test report) and are fully deducted from nitrogen fertilizer application rates.		Legume nitrogen credits are partially deducted from fertilizer application rates. (At least 50% of the nitrogen credit is used.)	Legume nitrogen credits are ignored. Fertilizer application rates are not adjusted.	
Organic wastes (such as whey and					

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sewage sludge)				
	Organic wastes are applied to fields at rates not exceeding the nutrient need of the crop to be grown.		Organic wastes are applied to fields at rates exceeding the nutrient need of the crop to be grown.	Organic waste application rate to fields is unknown.
Manure management <i>Note: the following series of categories deals with management practices pertaining to the land application of manure. If you do not apply manure to your property, skip to the next section.</i>				
Field selection	Manure is applied only to fields testing 7 ppm or less for available phosphorus (P) soil test		Manure is applied to fields testing from 7 to 20 ppm available soil test P.	Manure is applied to fields testing more than 20 ppm soil test P.
Animal units* to spreadable acres ratio	Less than 0.5 animal units per acre of spreadable cropland.	Between 0.5 and 1.0 animal units per acre of spreadable cropland.	Between 1.0 and 2.0 animal units per acre of spreadable cropland.	More than 2.0 animal units per acre of spreadable cropland.
Slope	Manure applied on fields with slopes of 0–2%.	Manure applied on fields with slopes of 2–6%.	Manure applied on fields with slopes of 6–12%.	Manure applied on fields with slopes greater than 12%.
Timing and method of application	Fall and/or spring manure applications of manure are injected or incorporated within three days of application.	Fall and/or spring manure applications of manure are incorporated within 4 to 7 days after application.	Fall and/or spring manure applications are left unincorporated for more than 7 days.	Fall manure applications are left on the surface (unincorporated) through the winter.
Uniformity of applications	Manure is applied uniformly across fields over a short period of time when emptying a storage facility.	Manure is applied relatively uniformly across fields on a daily haul basis.		Manure is applied in a random or nonuniform manner across fields.
Application rate	Manure spreader is calibrated and		Manure application rate is estimated visually.	Manure application rate is not estimated.

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	application rate is estimated by counting loads or other reliable method.			
Application strategy	Manure is applied at rates to meet the phosphorus (P) need of crop to be grown.	Manure is applied at rates not to exceed the crop removal of P and to maintain current soil test P levels.	Manure is applied at rates to meet the nitrogen need of crop to be grown.	Manure is applied without regard to crop nutrient need.
Field characteristics/site considerations <i>Note: Physical characteristics of cropland fields that limit their suitability for receiving manure include soil depth (less than 20 inches over bedrock); soil texture/tim-ing of application (early fall applications of manure on sands when soil temperatures are greater than 50 o F); proximity to surface water (applications within 200 feet of lakes and streams or in areas of concentrated water flow, such as water-ways and terrace channels).</i>				
	No cropland acres have physical characteristics that would limit their suitability for receiving manure.	A small percentage of cropland acres (less than 10%) have physical characteristics that would limit their suitability for receiving manure.	A moderate percentage of cropland acres (10-30%) have physical characteristics that would limit their suitability for receiving manure.	A significant percentage of cropland acres (more than 30%) have physical characteristics that would limit their suitability for receiving manure.
Nitrogen (N) fertilizer applications				
Sandy soils <i>Note: The following three categories pertain to nitrogen fertilizer management for corn on sandy soils. If your farm does not have sandy soils or if you don't raise corn, skip this section. If you have sandy and heavier soils on your farm, complete the following five categories.</i>				
Timing of N fertilizer applications`	Single sidedress (plus starter N) or multiple delayed applications of N.	Split applications of N involving preplant (60 lb/acre or less) and sidedress applications.		The majority or all of N is applied preplant or in the fall. <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Cover crops	Cover crops are established during the growing season or in	Cover crops are established on the majority of sandy fields.	Cover crops are established on the minority of sandy	Cover crops are not used.

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the fall after the primary crop is harvested on all sandy soil fields.		fields.		
Medium and fine-textured soils				
Timing of N fertilizer applications	Sidedress or split (preplant and sidedress) applications of N.	Preplant plus starter applications of N.	The majority or all of N applied in the fall.	
Phosphorus (P) and potassium (K) fertilizer applications				
Timing of P and K applications	Immediate incorporation of broadcast applications. Or Band application (such as starter fertilizer).	Incorporation within three days of broadcast application.	Broadcast applications to frozen soils of less than 6% slope.	Broadcast applications to frozen soils of greater than 6% slope.
Starter fertilizer rates				
	Starter fertilizer applications that have soil test values for phosphorus (P) and potassium (K) of optimum or less. Application rates based on soil test recommendations.	Starter fertilizer applications on soils that have soil test values for P and K of high or excessively high. Application rates delivering approximately 10-20 lb of N, 15-30 lb of P2O5 , 10-30 lb of K2O (such as 100 lb of 10-20-10).		Starter fertilizer applications in excess of 10-20 lb of N, 15-30 lb of P2O5 , 10-30 lb of K2O on soils testing high or excessively high for P and K.
Calibration of fertilizer application equipment				

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	Application equipment is adjusted and calibrated at least once a year.	Application equipment is adjusted and calibrated every other year.	Application equipment has not been calibrated in the last 5 years.	Application equipment has never been calibrated.	
Recordkeeping					
	Crop nutrient management decisions are based on detailed field history records (yield, manure applications, crop rotation, etc.).			Field history records are not kept.	
Soil conservation					
	A farm conservation plan is being followed that does not allow tolerable soil loss (T) to be exceeded for any cropland fields.	A farm conservation plan is being followed only on designated highly erodible land (HEL) acres. These acres are planned to not exceed T.	A farm conservation plan is being followed but the plan allows erosion in excess of T (for example, a plan includes alternate conservation systems).	No farm conservation plan is being followed. Visible evidence of soil erosion.	
Crop rotation					
	Rotation with more years of grass or legume forage crops than row crops.	Rotation of row crops with a grass or legume forage crop at least one out of every three years.	Rotation of row crops with small grain (oats, wheat, etc.) crops.	Continuous corn or other high intensity row crop(s).	



***Animal unit equivalency factors**

(one animal unit = 1000 lbs)

Animal Type	Animal unit equivalency factor	Animal type	Animal unit equivalenc y factor	Animal type	Animal unit equivalency factor
Dairy cattle		Swine		Ducks	
Milking and dry cows	1.4	Pigs (55 lb to mkt)	0.4	Per bird (wet lot)	0.2
Heifers (800-1,200 lb)	1.1	Pigs (up to 55 lb)	0.1	Per bird (dry lot)	0.01
Heifers (400-800 lb)	0.6	Sows	0.4		
Calves (under 400 lb)	0.2	Boars	0.5		
Beef cattle		Sheep		Chickens	
Steers or cows (1,000 lb to mkt)	1.0	Per animal	0.1	Layers	0.01
Calves (under 600 lb)	0.5			Broilers	0.005
Bulls	1.4				
		Horses		Turkeys	
		Per animal	2.0	Per bird	0.018

For example, 60 milk cows=84 animal units (60 x 1.4 = 84 animal units). If the farm has 120 acres of spreadable cropland, the animal unit to spreadable acres ratio is 0.7 (84 animal units / 120 acres = 0.7).

Assess the number of categories that you have given a **high risk** or **moderate to high risk**. The more high and moderate to high-risk ratings you have, the greater your risk for contributing to water quality problems. To avoid potential problems, you should look for ways to improve your rankings in the high-risk categories.

To assess your rankings of individual activities, use these guidelines:

- * *Low-risk practices (4s)* are ideal and should be your goal.**
- * *Low-to-moderate-risk practices (3s)* provide reasonable protection of water quality.**
- * *Moderate-to-high-risk practices (2s)* provide inadequate protection of water quality in most circumstances.**
- * *High-risk practices (1s)* indicate a high potential for degrading water quality.**

To fully interpret your potential for harming drinking-water quality through your nutrient management practices, you may also wish to consider a site assessment. The Site Evaluation Worksheet (Worksheet 11) ranks soil and subsurface geologic materials and their ability to protect groundwater and surface water quality. *Any site that falls in a category higher than low risk has a reduced ability to attenuate contaminants—that is, in those settings even low to moderate or moderate to high risk practices have the potential to degrade water quality.* If your farm is located on a high or moderate to high risk site, you should view the groundwater risk as being one category of risk higher than your rankings indicate, and you should develop a plan for implementing practices to enhance groundwater protection.

Vermont Farm*A*Syst publications are revisions from the Wisconsin and Minnesota prototype versions, with support from the National Farmstead Assessment System Program.

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The Vermont Natural Resources Conservation Districts, Vermont Department of Agriculture, Food & Markets, University of Vermont Extension, Vermont Department of Environmental Conservation, Vermont Department of Health, USDA Natural Resources Conservation Service, USDA Farm Service Agency, USDA Cooperative Extension Service and the U.S. Environmental Protection Agency jointly support Vermont Farm*A*Syst.

Revised 10/97

This project has been funded wholly or in part by the United States Environmental Protection Agency through the Nonpoint Source Management Program Section 319 grant to the Vermont Natural Resources Conservation Council. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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